Pacific Science (1974), Vol. 28, No. 4, p. 377–382
Printed in Great Britain

Redescription of *Anthopleura nigrescens* (Coelenterata, Actiniaria) from Hawaii[1]

DAPHNE FAUTIN DUNN[2]

ABSTRACT: The species of Hawaiian sea anemone described by Verrill (1928) as *Tealiopsis nigrescens* is redescribed and referred to the genus *Anthopleura*.

IN TWO PREVIOUS PAPERS (Dunn 1974*a*, *b*), I discussed the lack of recent taxonomic work on the sea anemones of Hawaii. This paper, dealing with an actinian first described from Hawaii by A. E. Verrill (1928) as *Tealiopsis nigrescens*, updates the taxonomy and describes the species in detail.

Observations were made on over 50 live animals, four dissected specimens, and histological sections of 10 others. Nematocyst measurements were made from 10 animals.

Anthopleura nigrescens (Verrill 1928: 26)

Tealiopsis nigrescens Verrill, 1928: 26.
Bunodactis nigrescens Carlgren, 1949: 65.

Habitat

This actinian occurs from the high intertidal down to the shallow subtidal zone on the undersides or in holes of pieces of rock and dead coral scattered along sandy shores; and also on rock benches, usually in cracks or tidepools.

Size

The diameter of the oral disc of an expanded anemone is generally 10–15 mm, approximately equal to that of the pedal disc. The central portion of the column is slightly narrower than either end. The height is about 10–15 mm also. Occasional individuals reach 20–25 mm in diameter and height.

Base

The strongly adherent base is usually circular in outline. The pedal disc is lighter in color than the column, normally being light brown. Mesenterial insertions are visible through it as dark radial lines.

Column

The color of the column, usually dark gray-brown or black, gave the animal its specific designation, but in individuals from some localities (e.g., Black Point, Oahu) it may have a reddish cast.

In life, the strongly adhesive verrucae (all about 0.5 mm in diameter) usually hold bits of gravel and broken shell (Fig. 1) so that the anemone may be completely encased in gravel. The verrucae, arranged in longitudinal endocoelic rows with 8–10 suckers per row, do not diminish in size basally, and extend down to the limbus. They may be paler than the rest of the column (Fig. 1).

White-tipped acrorhagi, which may have a pinkish cast in the specimens with a reddish column, form a single ring at the top of the parapet (Fig. 1), proximal to which is a shallow fossa. The acrorhagi are lobed (Fig. 2) and endocoelic in position. Therefore the number of acrorhagi is equal to that of the rows of verrucae.

Oral Disc

The oral disc is normally flat, although occasionally the anemone extends its oral area into a cone, at which times lips may be formed temporarily. The area immediately surrounding the mouth is black. The ground color of the oral disc is lighter than the column, and the mesenteric insertions are marked as dark lines. The endocoelic area between two such lines is

[1] This investigation was supported by National Institutes of Health Fellowship 1 FO2 GM54232-01 from the Institute of General Medical Sciences. Manuscript received 15 August 1973.

[2] University of Hawaii School of Medicine, Department of Pharmacology, Leahi Hospital, 3675 Kilauea Avenue, Honolulu, Hawaii 96816. Present address: School of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia.

FIG. 1. Expanded *Anthopleura nigrescens*. Note especially the bits of gravel held by the light colored verrucae, the acrorhagi, and the position in which the knobbed tentacles are held. (Photograph by S. Arthur Reed.)

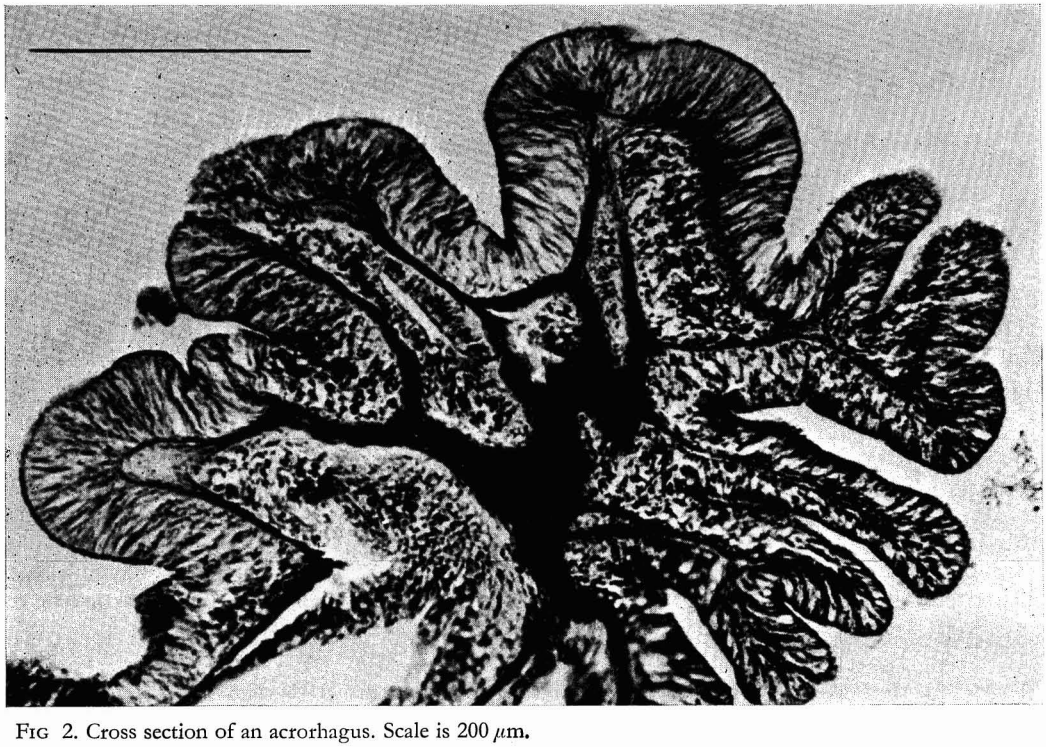

FIG 2. Cross section of an acrorhagus. Scale is 200 μm.

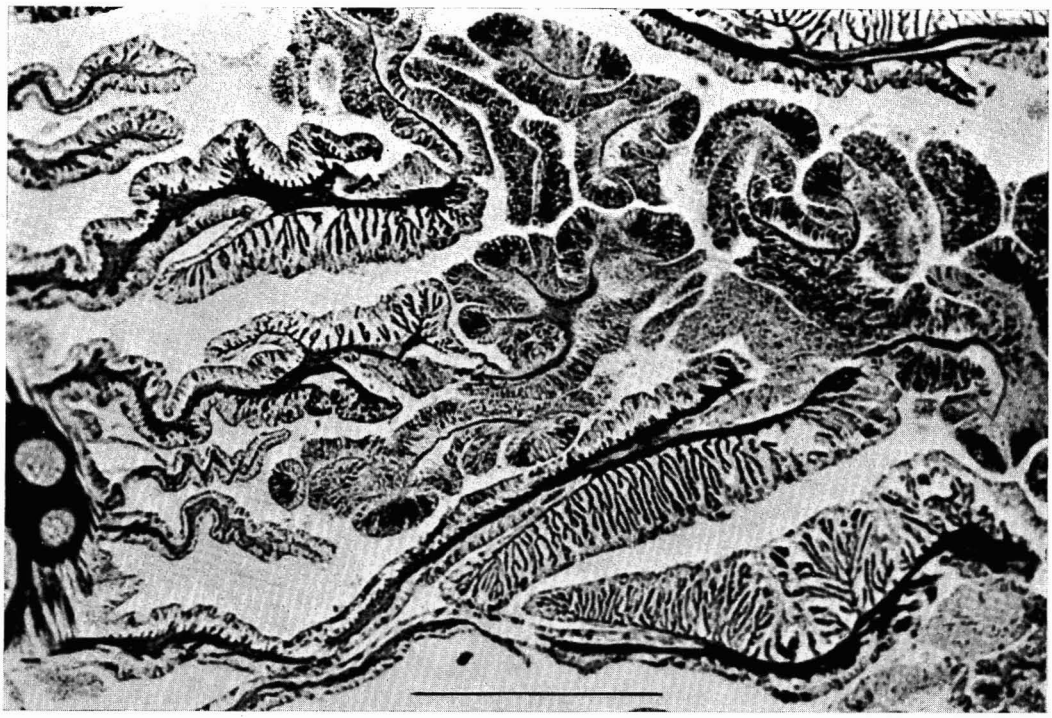

FIG. 3. Cross section of *Anthopleura nigrescens*. Note the free flap of the stronger retractor muscles. Scale is 500 μm.

lighter in color and may even be white, although those areas over the primary endocoels are sometimes orange. More than half the diameter of the oral disc is free of tentacles. The ectodermal radial musculature of the disc is strong.

Tentacles

The tentacles, which have perforate tips, occur only at the periphery of the oral disc, one over each exocoel and endocoel. Therefore, their number is twice as great as that of the acrorhagi, and ranged from 36 to about 80 in the several specimens in which they were counted. The inner tentacles are brownish gray to orange, usually the same as the color between the mesenterial insertions. They are typically 10–12 mm in length and are held more or less vertically (Fig. 1). The shorter outer tentacles, which are lighter in pigmentation, often almost transparent, hang downward over the margin. All the tentacles are very slim, blunt-tipped or even slightly knobbed (Fig. 1), and may be constricted at several points along their length. They change form quite readily, and those of preserved specimens are generally much shorter and stouter. Each inner tentacle, and occasionally the outer ones also, has a row of white splotches on its oral face (Fig. 1).

The tentacular circular musculature is endodermal and the longitudinal muscles are ectodermal. The ectoderm comprises about 70 percent of the cross-sectional width of the tentacle wall, and the endoderm 20 percent.

Mesenteries and Internal Anatomy

The retractor muscles are strong and are generally diffuse, although those of the intermediate cycles of mesenteries may be almost reniform. The peripheral edge of the strongest retractors forms a free flap one-third to one-half the length of the attached portion of the muscle (Fig. 3). The mesogleal lamellae of the stronger retractors are more highly branched than are those of younger mesenteries. The parietobasilar muscles are also strong, with a free flap at their inner edge.

The mesenteries have large oral stomata and smaller marginal stomata. The number of

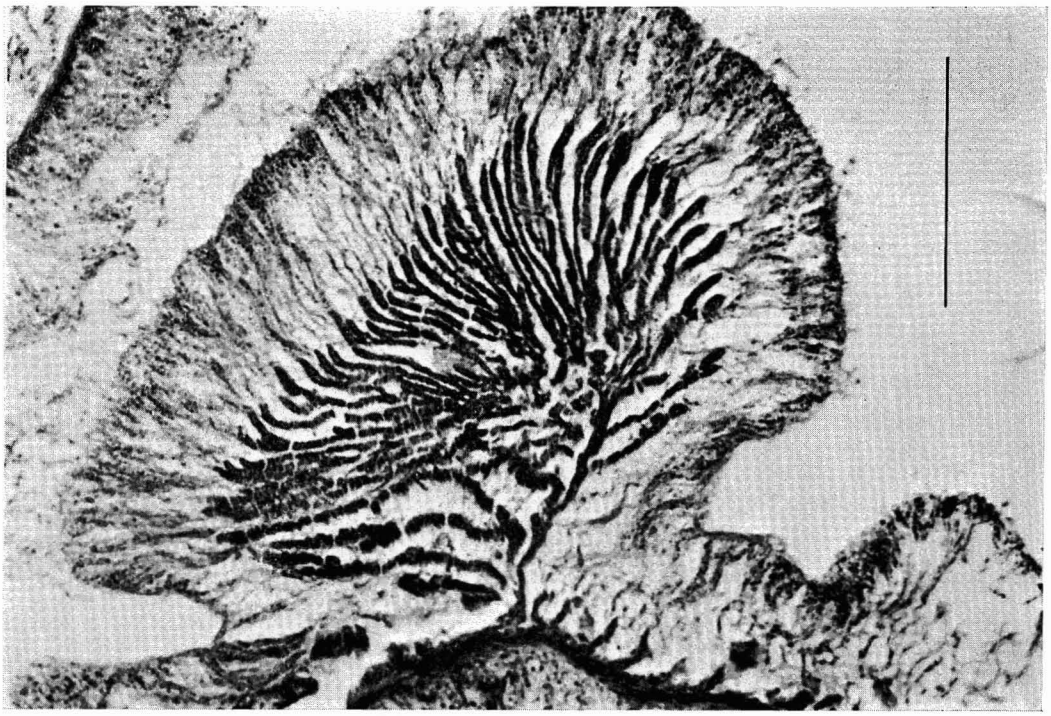

FIG. 4. Cross section of the sphincter of *Anthopleura nigrescens*. Scale is 90 μm.

mesenteries is the same at both ends of the column, and all but the smallest have tripartite mesenterial filaments. Most or all of the stronger mesenteries are fertile in gamete-bearing individuals, but only ova were seen. It is likely, therefore, that this species is dioecious. The majority of the mesenteries are complete.

The white, ribbed actinopharynx is half the length of the column. The ectoderm and endoderm of the actinopharynx are about equal in width and the mesogleal layer is less than one-third the width of each except in the ribs, where the mesoglea accounts for most of the increased width. In the ribs the ectoderm is often somewhat wider and the endoderm equal or slightly narrower than in other parts of the throat. Up to four siphonoglyphs were seen in animals that had been sectioned transversely, but none of the mesenteries attached to siphonoglyphs were directives. In fact, no directive mesenteries were found. The mesenteries attached to the siphonoglyphs were fertile in some individuals.

The relatively weak circumscribed oval sphincter is located at the base of the shallow fossa proximal to the acrorhagi. Its mesogleal processes are more or less pinnately arranged and not highly branched (Fig. 4). They are longer and more numerous on the basal than the oral side.

The circular musculature of the column is endodermal. The ectoderm and endoderm of the column are equally thick, each being three to six times the width of the mesoglea.

This species lacks zooxanthellae.

Cnidom

Spirocysts, basitrichs, atrichs, microbasic *p*-mastigophores.

Distribution and Size of Nematocysts

TENTACLES: Spirocysts, 10.3–28.2 × 1.9–3.8 μm (67); basitrichs, 16.0–21.6 × 1.7–2.8 μm (84).

ACRORHAGI: Spirocysts, 14.1–28.2 × 1.9–3.6 μm (66); atrichs, 27.3–43.2 × 2.8–4.7 μm (61).

COLUMN: Basitrichs, 11.3–16.0 × 1.7–2.4 μm (59); basitrichs, 16.5–22.6 × 2.4–3.8 μm (74).

ACTINOPHARYNX: Basitrichs, 20.7–27.3 × 1.9–2.8 μm (53).

FILAMENTS: Basitrichs, 13.2–18.7 × 1.7–2.6 μm (62); basitrichs, 20.7–29.1 × 2.4–3.8 μm (36); microbasic *p*-mastigophores, 15.0–18.8 × 2.8–4.7 μm (37).

Distribution

I have found this species on rocks along the sandy beach of Moku-o-Loe (Coconut Island) in Kaneohe Bay, Oahu, on the rocky benches between Black Point and Diamond Head, and on rocks along Kewalo Basin. I have failed to find it on the rock benches of Hanauma Bay, and in several sand-and-rock habitats along the east and north shores of Oahu. I have not looked for it on islands other than Oahu. Verrill's type material came from Kauai.

This species has been observed in aquaria to divide longitudinally, and this may account for the lack of directive mesenteries in the specimens examined histologically.

DISCUSSION

Verrill's (1928) description of *Tealiopsis nigrescens* is brief and quite accurate in the few details it provides. However, his statement that "The rows [of verrucae] are the same as the number of tentacles..." is clearly incorrect, since there are exactly twice as many of the latter as the former. It has been my experience that all the verrucae are about the same size, although Verrill says differently. I did not have the opportunity to examine Verrill's type material, but there is no doubt that his description refers to the species redescribed in this paper.

In Carlgren's (1949) monograph of the sea anemones of the world, the genus *Tealiopsis* is not recognized, and species that had been assigned to it are placed partly in the genus *Stomphia*, partly in *Bunodactis*. The endodermal sphincter of the Hawaiian species clearly rules out its inclusion in *Stomphia*, a member of the subtribe Mesomyaria. Carlgren (1949) placed *Tealiopsis nigrescens* in *Bunodactis*, perhaps because Verrill (1928) had not mentioned that the anemone has acrorhagi. Species of *Bunodactis* may have marginal pseudospherules, but not marginal spherules. The possession of the latter (acrorhagi) by *Tealiopsis nigrescens* definitely places it in the genus *Anthopleura*. This fact has been recognized by marine zoologists in Hawaii for some time, and the name *Anthopleura nigrescens* has been used in publication (Matthew 1967, Rosin 1969).

Carlgren (1949) recognizes 29 species of *Anthopleura*, 19 of them from the Pacific Ocean and/or the Indian Ocean. In addition, Stephenson (1935) mentioned that anemones he saw on the Great Barrier Reef and the "Cape Peninsula" are similar or identical to *A. thallia*, which is listed by Carlgren (1949) as a North Atlantic and Mediterranean species. At least seven of these 20 species possess zooxanthellae. Although Stephenson (1928) stated that color is often unreliable as a systematic character in sea anemones, it is very consistent in *A. nigrescens* and, therefore, can be considered in comparisons with other species. None of the 20 conforms to the description of *A. nigrescens*.

Since the publication of Carlgren's (1949) monograph, five new species of *Anthopleura* have been described: *A. elatensis* (England 1969), *A. panikkarii* (Parulekar 1968), *A. midori*, *A. kurogané*, and *A. asiatica* (Uchida and Muramatsu 1958); two species formerly assigned to other genera have been redescribed as belonging to *Anthopleura*: *A. elegantissima* and *A. artemisia* (Hand 1955); and the development of an unnamed species of *Anthopleura* was studied (Atoda 1954). All of these additions are Indo-Pacific and all differ from the Hawaiian species in some respects. Therefore, the small black sea anemone from Hawaii, described by Verrill (1928) as *Tealiopsis nigrescens*, remains a valid species and is reassigned to the genus *Anthopleura*.

ACKNOWLEDGMENTS

I wish to thank Dr. S. Arthur Reed for taking photographs of *Anthopleura nigrescens*, and Dr. Cadet Hand for his critical reading of the manuscript. I acknowledge the use of facilities in the Departments of Pharmacology, Pathol-

ogy, and Tropical Medicine/Medical Microbiology of the University of Hawaii School of Medicine, Leahi Hospital.

LITERATURE CITED

ATODA, K. 1954. Postlarval development of the sea anemone, *Anthopleura* sp. Sci. Rep. Tôhoku Univ., 4th ser. (Biol.) 20: 274–286.

CARLGREN, O. 1949. A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria. K. svenska VetenskAkad. Handl., Fjärde ser. 1(1): 1–121.

DUNN, D. F. 1974*a*. *Actiniogeton sesere* (Coelenterata, Actiniaria) in Hawaii. Pacif. Sci. 28: 181–188.

———. 1974*b*. *Radianthus papillosa* (Coelenterata, Actiniaria) redescribed from Hawaii. Pacif. Sci. 28: 171–179.

ENGLAND, K. W. 1969. *Anthopleura elatensis* n. sp. (Actiniidae: Actiniaria) from the Red Sea. Israel J. Zool. 18: 1–7.

HAND, C. 1955. The sea anemones of central California. Part 2. The endomyarian and mesomyarian anemones. Wasmann J. Biol. 13: 37–99.

MATHEW, K. 1967. Observations on *Anthopleura nigrescens* (Verrill). Bull. Dep. mar. biol. Oceanogr., Trivandrum Univ., India 3: 41–44.

PARULEKAR, A. 1968. On a new species of sea anemone from Maharashtra, India. J. Bombay nat. Hist. Soc. 65: 590–595.

ROSIN, R. 1969. Escape response of the sea-anemone *Anthopleura nigrescens* (Verrill) to its predatory eolid nudibranch *Herviella* Baba spec. nov. Veliger 12: 74–77.

STEPHENSON, T. A. 1928. The British sea anemones. Vol. 1. Ray Society, London. xii + 148 pp., 14 pls.

———. 1935. The British sea anemones. Vol. 2. Ray Society, London. ix + 426 pp., 33 pls.

UCHIDA, T., and S. MURAMATSU. 1958. Notes on some Japanese sea-anemones. J. Fac. Sci. Hokkaido Univ., ser. 6 (Zoology) 14: 111–119.

VERRILL, A. E. 1928. Hawaiian shallow water Anthozoa. Bull. Bish. Mus. 49. 30 pp.